NASA Facts

National Aeronautics and
Space Administration

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American Lives Touched by Space - How NASA Science Benefits Everyone

Every day, in a variety of ways, American lives are touched by space. NASA is celebrated worldwide for having accomplished things in its history that no one has ever done before. None of those achievements happened entirely by accident. They are the result of management innovation, revolutionary technologies and solid science and research. The following are just a few of the many examples of the significant impacts NASA has made as a result of human space flight, space and earth science and aeronautics.

Existing Practical Benefits

Just a Phone Call Away: Whenever long distance telephone calls are made and it seems the caller's just around the corner, remember this is a result of NASA's communications satellite technology, developed over more than 30 years.

The Pulse: The monitoring systems used in intensive care units and in heart rehabilitation wards were developed from the systems used to monitor the heartbeats of astronauts during the first space missions in the early 1960s. A single nurse can now monitor several patients in critical care situations. Countless Americans recovering from heart attacks and other serious illnesses or injuries owe their lives to this technology — a direct result of NASA's space program.

Fighting Food Poisoning: The Food and Drug Administration and the United States Department of Agriculture credit NASA with developing a system to make sure the food in the United States is safe to eat. The system is called the Hazard Analysis and Critical Control Point (HACCP), and it was originally invented for astronauts' food. It includes principles for preventative food safety measures, such as minimum cooking temperatures to kill bacteria. It also establishes methods of dealing with food safety hazards. HACCP has become the food industry standard worldwide.

Planes, Trains and Automobiles - and More: NASTRAN is a computer software program that likely has touched every American. The software saves time and money by using a computerized design to identify what's good and bad about a product before it is ever actually manufactured. NASTRAN and its offshoots in the private sector are used in everything from chemical plants, refineries and trains to next-generation fighter aircraft, cars, acoustic speakers, electric guitars, and skyscrapers. NASTRAN was developed for human space flight and for aerospace/aviation, but private companies that offer offshoots of the original program have a direct revenue of more than $1 billion a year, and the software affects hundreds of billions of dollars worth of consumer products.

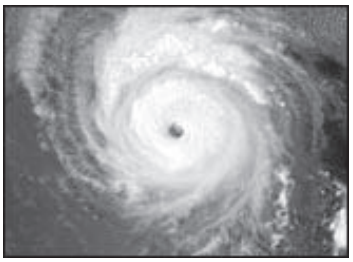
Life-saving Search and Rescue: An international satellite-based search and rescue system derived from NASA's research in developing and demonstrating beacon locators from space has helped save close to 13,000 lives (as of January 2002) worldwide since its inception. This system is now operational 24 hours a day, 365 days a year, automatically detecting and locating transmissions from emergency beacons carried by ships, aircraft, or individuals. Appropriate rescue authorities are automatically alerted. There are 29 other participating nations in the program today.

Aerial photo of a shipwrecked sailboat in a marsh, carried there during a storm.

Groovy Runways: NASA researchers determined that cutting thin grooves across concrete runways reduces the risk of hydroplaning. The grooves create channels for excess water to drain, and they've been shown to improve aircraft tire friction performance in wet conditions by 200 to 300 percent. As a result, hundreds of commercial airports around the world have had their runways grooved. Every state nationwide uses this technique on at least some of its main highways, interstate highway curves and overpasses; pedestrian walkways, ramps and steps; food processing plants and cattle holding pens. Grooves on slippery highways are part of the reason accidents are down as much as 85 percent. It is possible this is NASA's most successful technology in terms of lives saved and injuries and accidents avoided.

Bumper Crops: Using intense lighting and high levels of carbon dioxide to grow crops in water, NASA-sponsored researchers trying to grow plants in space found a way to produce world record crops on Earth. Their hydroponics techniques allowed them to grow in the laboratory a wheat crop five times larger than ever before in the field. Several growers and large corporations now use NASA's techniques in producing potatoes.

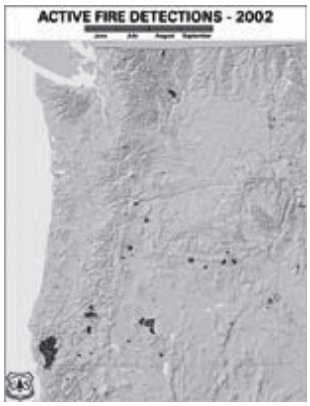
Hurricane Prediction: NASA and the National Oceanic and Atmospheric Administration (NOAA) use remote sensing observations to enhance hurricane track, landfall, and intensity forecasts. Measurements from NASA's Tropical Rainfall Measuring Mission (TRMM) and QuikScat Earth-observing satellites help to improve predictions about hurricanes and other tropical systems as they move from the open ocean to coastal regions. Reducing hurricane track error means pinpointing precise regions for evacuation in advance of a predicted landfall. Better forecasts have considerable societal impact, including cost savings.



A Geostationary Operational Environmental Satellite image of Hurrican Andrew, August 1992.

Big Impact From a Small Package: Micro-electrical Micro-mechanical Systems (MEMS) are extremely small devices and sensors - as small as a single human hair. Many MEMS products are directly traceable to the miniature accelerometers NASA developed in the 1970s for human and robotic space flight. Accelerometers measure sudden changes in speed. MEMS products now are used to trigger automobile airbags, to regulate pacemakers, and even to keep washers and dryers balanced. MEMS are now part of a growing $3 billion per year industry. In fact, 83 patents reference the original NASA-sponsored work on a MEMS accelerometer — the earliest reference was in 1975 and the latest was April 2003.

Rapid Response To Wildfires: In the summer of 2000, wildfires burned 8.4 million acres in the western US. NASA and the US Forest Service have developed a rapid response capability based on direct broadcast from NASA's Terra and Aqua satellites for use by the USFS in wildfire management. Everyday, the Moderate Resolution Imaging Spectroradiometer (MODIS), which is onboard the Terra and Aqua satellites, provides an image of fires across most of United States. This helps federal agencies manage wildfires more effectively, both during and after the event.



Composite MODIS image of acive fires in Northwest U.S., June - September 2002.

HST Improves Biopsies: Breast examinations-mammographies-help in the detection of breast cancer. With the help of Hubble Space Telescope technology, biopsies can be performed with a needle instead of a scalpel, saving the patient time and pain, and leaving only a small needle mark rather than a large scar. The procedure costs about $850 compared to about $3,500 for a traditional biopsy.

Radiologist operates the Breast Biopsy System that uses technology developed for the Hubble Space Telescope Imaging Spectrograph.

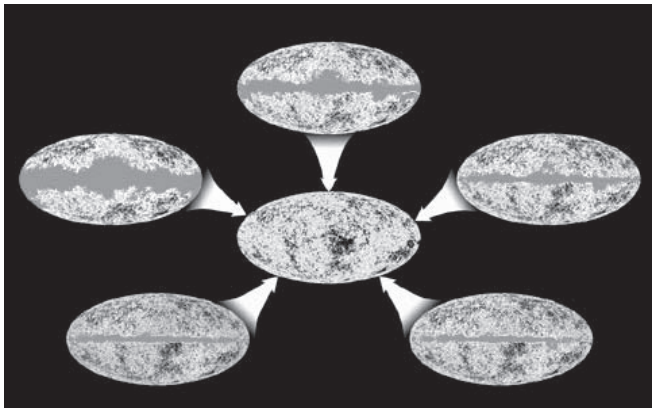
Recent Spinoffs With Human Interest Impact

Life-saving Tool: Lifeshears — a handheld cutter — cuts through car doorposts, roofs, or steering wheels to free victims from auto wrecks and other dangerous situations. It uses the same power source that separates solid rocket boosters from Space Shuttles. In the hands of rescue workers searching for survivors at the Oklahoma City bombing in 1995 and the World Trade Center in 2001, this tool made quick work of cutting through exposed metal. Hi-Shear Technology Corporation of Torrance, Calif., firefighters and NASA combined brainpower and dollars to develop this tool that is lighter, cheaper and easier to use than traditional hydraulic-powered rescue equipment.

Shedding New Light On Cancer Treatment: New lighting technology originally developed for plant growth experiments in space is finding a novel use by doctors treating brain and skin tumors and other medical problems such as wounds. The technology is helping doctors at the Medical College of Wisconsin in Milwaukee improve a chemotherapy technique called photodynamic therapy that uses focused light to activate medicines to kill cancerous tumors. Traditionally, a laser is used for the light source. But NASA research provided a more efficient and versatile light source as a cheaper, more accurate alternative to lasers. NASA is also investigating this technique as a method of helping astronauts' wounds heal faster than they typically do in space.

Future Benefits: Where NASA Research and Technology Changed the Direction of Research on Earth

Age of the Universe: In February 2003, NASA released the results of a 1 year observation of the entire sky by the Wilkinson Microwave Anisotropy Probe (WMAP) showing the afterglow or cosmic microwave background of the universe 380,000 years after the Big Bang. One of the biggest surprises revealed in the data is the first generation of stars to shine in the universe ignited only 200 million years after the Big Bang, much earlier than many scientists had expected. Also, the



WMAP composite image of our Milky Way, illustrated in five frequency bands.

new portrait precisely pegs the age of the universe at 13.7 billion years old, with a remarkably small 1 percent margin of error.

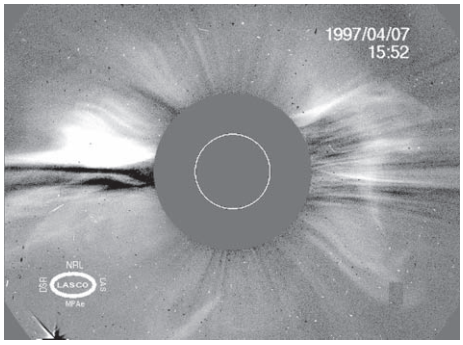
Innovation and Inspiration — a Classic NASA Story: At NASA, unusual applications often arise from unusual challenges. Dr. Rafat Ansari, who worked with fluid physics experiments conducted by astronauts in space, found an unusual use for a NASA device when his father faced a medical challenge: cataracts. The physics experiments looked at colloidal systems, small particles that are suspended in liquids, a description which also happened to fit the nature of his father's eye disease. In a flash of insight, Dr. Ansari realized that the instrument being developed as part of the colloids experiment might be able to detect cataracts - possibly earlier than ever before. The device is now being used to assess the effectiveness of new, non-surgical therapies for early stages of cataract development. Cataracts affect 50 million people annually. The instrument is also being adapted as a pain-free way to identify other eye diseases, diabetes, and possibly even Alzheimer's.

The device also may have an unexpected return for NASA. It is being investigated as a possible medical tool for astronauts, who may develop cataracts as a side effect of the kind of radiation exposure that they might experience in long-duration space flight.

At NASA, it's also true that extraordinary goals inspire exceptional minds. In this case, the exceptional mind that used a physics experiment to help people like his father was inspired to pursue scientific research by a single moment: when he was a little boy, in Pakistan, and saw people walk on the moon.

Bolstering the Case for Dark Energy: In 2001, NASA announced that the Hubble Space Telescope had seen a burst of light from an exploding star located much farther from Earth than any previously seen. This stellar explosion was extraordinary because its discovery greatly bolstered the case for the existence of a mysterious form of "dark energy" pervading the universe. The concept of dark energy, which shoves galaxies away from each other at an ever-increasing speed, was first proposed, and then discarded, by Albert Einstein early in the last century. The Hubble discovery reinforced the startling idea that the universe only recently began speeding up, a discovery made about three years ago when the unusually dim light of several distant supernovas suggested the universe is expanding more quickly than in the past, but there were alternate explanations. The more distant supernova refuted these alternatives and offered the first tantalizing observational evidence that gravity began slowing down the expansion of the universe after the Big Bang and only later did the force of dark energy win out over gravity's attractive grip and begin accelerating the expansion of the universe.

First Complete Recording of a Solar Eruption: In 1997, for the first time, the space observatories Wind and SOHO, helped scientists follow an interplanetary weather event that carried a blast of high-energy particles from the Sun to Earth. The blast (a coronal mass ejection) was born on the Sun and reached Earth four days later where it began pumping vast amounts of energy into the Earth's environment. It triggered auroral displays and disrupted radio communications. This was the first solar eruption recorded



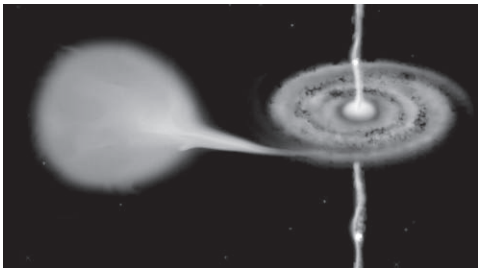
A coronal mass ejection travels towards Earth on April 7, 1997. Credit: NASA/ SOHO

from "cradle to grave". The Sun has profound effects throughout the solar system, both on the bodies that orbit our own star and on the space between them. To explain these effects, we need to understand both the inherent characteristics of the Sun and how its emissions interact with the rest of the solar system. These interactions at Earth are particularly important because of their practical near-term effects (e.g., interference with satellite communications) and possible long-term implications (e.g., the effects of solar variability on Earth's climate).

New Science Textbooks to Reach 100 Million Students: A first of its kind collaboration between NASA and textbook publisher Pearson Education Inc. will ensure more than 100 million K-12 students and anyone with access to the Internet can learn about science, technology, engineering, and mathematics, based on actual data from NASA's latest discoveries and technologies. In the year 2000, 31 percent of the material in astronomy textbooks was based on discoveries made through NASA's Space Science research.

Aviation Safety Improvements to Reduce Fatalities By 90 Percent: Several ongoing NASA efforts will combine to reduce the fatality rate for general aviation accidents by as much as 90 percent within the next 15 years. These programs are improving such critical safety factors as weather situational awareness, crash worthiness, engine reliability, systems and displays, maneuvering control and traffic control management.

Nobel Prizes (a): Black Holes: Riccardo Giacconi received the 2002 Nobel Prize in physics for "pioneering contributions to astrophysics" which have led to the discovery of cosmic X-ray sources. Giacconi discovered the first X-ray stars and the X-ray background in the 1960s and, with funding from NASA has also detected sources of X-rays that most astronomers now consider to contain black holes. His continued research with the Chandra X-ray Observatory has led to the discovery that the universe is teaming with black holes, and a super massive black hole exists at the center of the Milky Way Galaxy.


An X-ray image of black hole candidate XTE J1118+480. Credit: NASA/Chandra X-Ray Observatory Center

(b) Atom Lasers: The 2001 Nobel Prize for physics was awarded to three scientists, including a Massachusetts Institute of Technology physicist whose NASA-funded research uses ultra-cold atoms that form a new type of matter. The Royal Swedish Academy of Sciences said Dr. Wolfgang Ketterle and two other scientists caused atoms to "sing in unison." Through their research, atomic particles were induced to have the same energy and to oscillate together in a controlled fashion. Laser light has these qualities, but researchers have struggled for decades to make matter behave this way. The breakthrough research has potential uses for extremely precise measurements. The discoveries may lead to microscopic computers and ultra-precise gyroscopes that could dramatically improve aircraft guidance and spacecraft navigation.

For more information about NASA's many other technological developments, visit www.nasa.gov